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Sinus En Bloc Inlay Grafting With Lateral Approach and Bone Lid Replacement: Report of a Series of Cases

Ludovico Sbordone, MD, DDS, Carolina Sbordone,†*
Paolo Toti, BSc, DDS,‡ GiovanBattista Menchini-Fabris, DDS,§
Luigi Califano, MD,‖ and Franco Guidetti, MD¶

Posterior maxillary regions are often a problematic area for implant placement because of insufficient quality and quantity of available bone, arising from combined advanced resorption of alveolar crest and increased pneumatization of the maxillary sinus.[1]

A sufficient volume could be created by several types of grafting procedure. The basic surgical technique, designed to treat such atrophy and provide adequate bone volume for implant positioning, is the "sinus lift," initially described by Boyne et al[2] and Tatum.[3]

Sinus lift by a modified Caldwell-Luc procedure, in which the lateral wall of the maxillary sinus is cut, removed, and then, after sinus grafting with autologous bone block, reset into its original position, has been described for cases with an extremely reduced sinus floor.[4]

The aim of the present report of cases of patients treated by sinus lift, as per Sailer,[4] and delayed implant insertion is to report possible advantages of the technique as well as potential complications and their treatment or prevention.

Report of Cases

Five patients, from June through December 2007 (1 female and 4 male), aged 41 to 62 years (mean age 50.8 ± 8 yrs), requesting implant-supported fixed restoration and showing advanced maxillomandibular atrophy, were bilaterally treated in the posterior maxilla, by sinus lift as per Sailer.[4]

Briefly, the technique adopted for this area was the following: at the maxillary sinus lift site a horizontal midcrestal incision and 2 vertical releasing incisions were performed, allowing adequate reflection of a full-thickness flap and the exposure of a wide surgical site extending from the canine fossa to the lateral zygomaticomaxillary pillar. The lateral wall of the maxillary sinus was largely fenestrated: an inferior horizontal osteotomy line was positioned, beveled at the sinus floor level; and a superior horizontal osteotomy line was apically drawn at a distance that provided adequate access for the positioning of the planned bone block graft. Anterior and posterior vertical osteotomies were performed at the borders of the sinus. The lateral wall, before removal, was prepared to host 2 miniplates positioned at opposite sides (L-shape Micro Plate System, with profile height 0.6 mm, and screw −1.5 mm diameter, (Gebrueder Martin GmbH, KLS Martin Group, Tuttlingen, Germany) (Fig 1). After removal, the large bone lid, deprived of the adherent Schneiderian membrane, was stored in sterile gauze soaked with saline solution. The mucosal lining was wholly cut off between the pristine sinus floor and an imaginary line drawn 3 mm above the superior border of the planned graft.[4]

Iliac crest autologous bone block grafts were harvested as per Grillon et al.[5]

The corticocancellous bone blocks were shaped to adapt to the sinus and were tried out on a sterile stereolithographic model obtained by rapid prototyping (Materialize Dental Italia, Rome, Italy) (Fig 2).

Once the final shape had been obtained, the graft was placed into the sinus and secured to the denuded antral floor by fixation screws (at least 2 in each case) positioned with a lag screw technique.[6] The bone lid, secured in its pristine position, was covered by free-standing oral mucosa mobilized through Rehrmann horizontal periosteal incisions.[7,8]

*Professor and Chairman, Implantology and Periodontology, Department of Surgery, University of Pisa, Italy. Advanced Implantology, Azienda Ospedaliero–Universitaria Pisana, Pisa, Italy.

†Medical Student VI Year, Department of Maxillo-Facial Surgery, University of Naples: Federico II, Napoli, Italy.

‡Research Fellow, Department of Surgery, University of Pisa, Italy. Advanced Implantology, Azienda Ospedaliero–Universitaria Pisana, Pisa, Italy.

§Research Fellow, Department of Surgery, University of Pisa, Italy. Advanced Implantology, Azienda Ospedaliero–Universitaria Pisana, Pisa, Italy.

‖Professor and Chairman, Maxillo-Facial Surgery, Department of Maxillo-Facial Surgery, University of Naples: Federico II, Napoli, Italy.

¶Medical Staff, Azienda Ospedaliero-Universitaria Pisana: Maxillo-Facial Surgery, Complex Operating Unit, Pisa, Italy.

Address correspondence and reprint requests to Dr Sbordone: Department of Surgery, University of Pisa, via Roma 67, 56126 Pisa, Italy; e-mail: lsbordon@med.unipi.it

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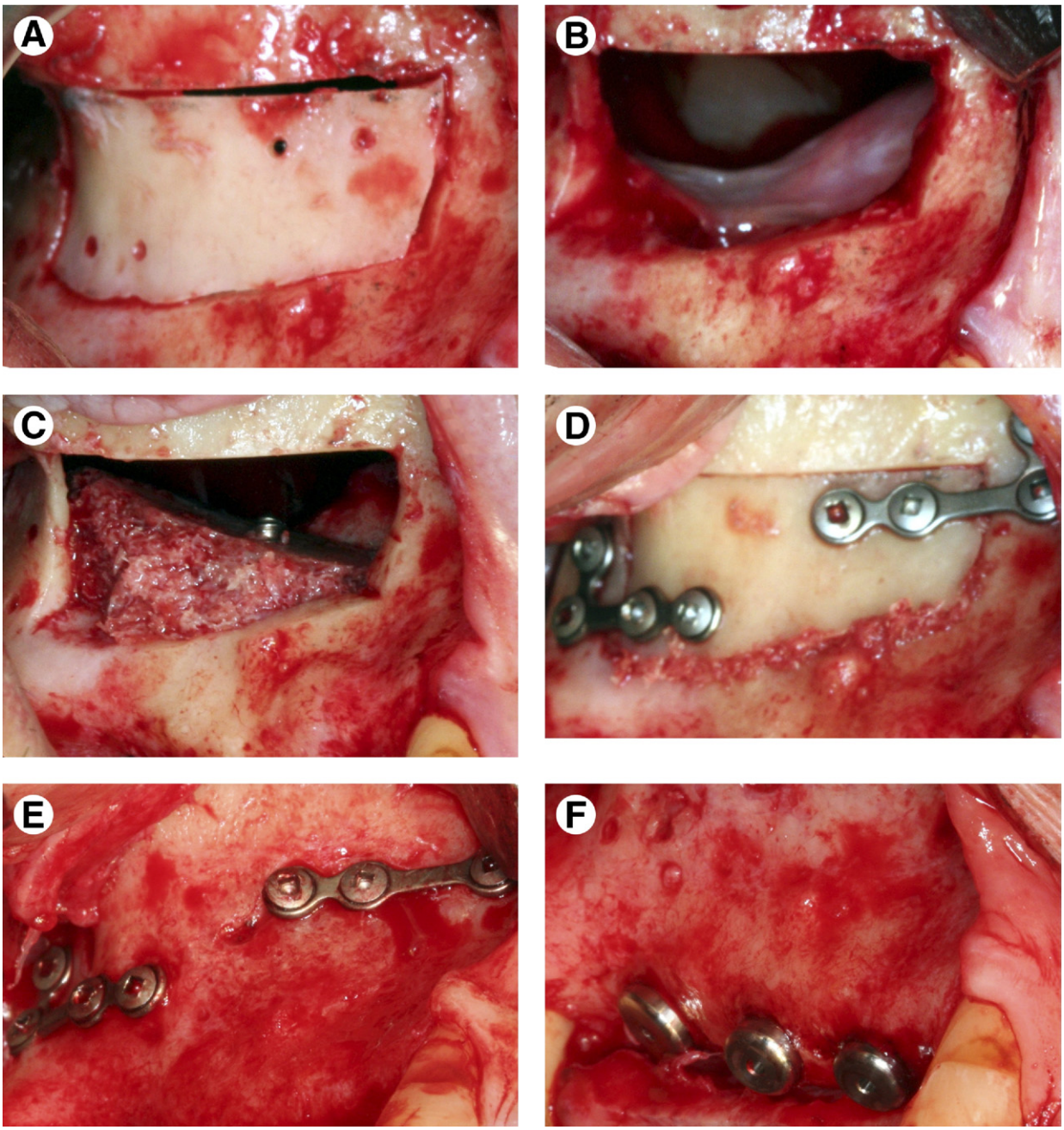

FIGURE 1. *A, B,* Sinus window before and after bone lid removal. *C,* Bone blocks secured by titanium lag screws. *D,* Bone lid fixed with 2 L-shaped Micro Plate Systems, with profile height 0.6 mm, and screw −1.5 mm diameter, − (KLS Martin Group, Germany). *E,* Grafted site 4 months after reconstruction. *F,* Implants positioned in reconstructed bone.

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All patients received appropriate perioperative chemoantibiotic and analgesic/anti-inflammatory therapy.

The study was approved by the Scientific Ethics Committee of the University of Pisa.

PATIENTS 1 TO 3

None of these patient showed clinical signs or symptoms of maxillary sinusitis preoperatively, although 3 single sinuses from different male patients presented radiological signs of localized sinus disease, identified as sinus membrane thickness ≥3 mm on CT scan.[9] One patient had complete bony septa in the medial walls (left anterior and right posterior). Before operation, patients were treated with amoxicillin-clavulanic acid (1 g orally twice a day), which was continued postoperatively, and the clinical perviousness of the naso-sinusal passage was endoscopically assessed. The postoperative course after the sinus lift was uneventful. At the second surgery, for implant positioning, the lateral bony wall of the sinus appeared in all sites to be completely restored, and the integrity of the lateral zygo-

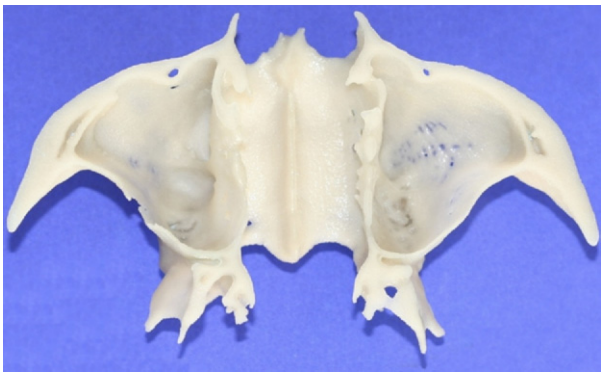

FIGURE 2. View of the sterile stereolithographic model of the sinus cavities obtained by rapid prototyping (Materialize Dental Italia).

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maticomaxillary pillar was ensured. Consequently, no soft tissue encleftation appeared in the window area.

The 3 patients received 17 implants (Table 1) in the sinus-lifted and grafted areas 4 months after the initial procedure. Implant positioning progressed uneventfully.

PATIENTS 4 AND 5

Both patients (1 male and 1 female) were preoperatively free of clinical signs or symptoms of sinusitis. The female patient presented, at the radiographic examination, with an incomplete anterior bony septum of about 5 mm in height in the right lateral wall and a minor septum of about 2 mm in height in the posterior portion of the left sinus. In patient 5, sinus septa were not present. Both patients had received pre- and postoperative antibiotic prophylaxis with ceftriaxone (1 g intramuscularly per day).

Both patients developed postoperatively symptoms of acute bilateral maxillary sinusitis, namely, fever, fatigue and malaise; facial swelling and pain that increased upon bending forward; and an addition of mucus-purulent discharge from the maxillary sinus respectively 29 and 20 days after sinus augmentation. These patients also displayed symptoms of additional paranasal sinus involvement. Computed tomography transverse sections revealed the presence, in all pathologic sinuses, of a radiopaque material that prompted posterior nasal drainage of the secretions, causing pooling and coughing, nausea, muffled hearing, and nasal congestion. No intraoral wound dehiscence was found.

Acute postoperative infections of the lifted maxillary sinuses were treated with appropriate chemo-antibiotic and corticosteroid therapy, combined with antral irrigations of chlorhexidine gluconate to drain pus and mucus.

The patients were treated with bilateral functional endoscopic sinus surgery (FESS) as per Messerklinger.[10] In the female patient, 2 months after the FESS surgery, a partial necrosis of the right intrasinusal bone block graft was observed. The necrotic bone was operatively removed, endoscopic nasal antrostomy of the middle meatus again performed, and the wound closed with a buccal fat pad technique. Subsequent healing was uneventful. In this patient, bacterial sampling during sinusitis showed prevalence of *Streptococcus constellatus*, and postoperative culturing showed *Candida albicans*. A complete opacification of the maxillary sinus was evident radiologically.

At the postoperative CT scan, the right and left grafted autogenous bone blocks were 7 to 9 mm thick, and the right bone block did not totally cover the septa, especially in the anterior-lateral maxillary sinus wall (Fig 3). None of the grafts reached the natural ostium of the maxillary sinus (Fig 3), but all 4 maxillary sinuses, in the 2 patients, showed a pattern of inflammatory disease in the coronal plane, with mucus and mucosal thickening in the maxillary sinus that the osteo-meatal complex was not able to drain.

At the time of implant placement, 3 of 4 sinus lateral bony walls appeared completely restored, although the right lateral wall of the female patient, in which partial necrosis occurred, showed extensive destruction. The integrity of the lateral zygomaticomaxillary pillar was ensured for all sites.

In these 2 patients, 11 implants (Table 1) were placed in all sinus-lifted areas, including the area in which the partial necrosis occurred, 15 weeks after resolution of the complications described. Implant positioning progressed uneventfully.

Discussion

The aim of the present report is to describe the possible advantages as well as the potential complications of sinus lift as per Sailer,[4] along with possible ways of treating or preventing such complications.

Data from a recent review paper[11] indicated that particulate materials grafted in maxillary sinus lift procedures showed 2 main complications: *1)* the perforation of the sinus membrane, which was the most common intraoperative complication, with a mean prevalence of 19.5% (range 0% to 58.3%); and *2)* the infection of the grafted sinuses, with a mean incidence of 2.9% (range 0% to 7.4%). Perforation of the sinus membrane is, in turn, the primary cause of sinusitis.[12,13] Excessive bleeding from the sinus membrane or the bony window, hematoma, cyst forma-

Table 1. DISTRIBUTION OF DENTAL IMPLANTS IN THE 5 CASE REPORTS

	Diameter mm	3.75				4.10				5.00			
	Length mm	8.5	10	11.5	13	8.5	10	11.5	13	8.5	10	11.5	13
Patients 1-3	No.			3	2		2	3	3		1	3	
Patients 4 and 5	No.	1	1	1	1	1	1	1	3			1	

Table shows diameter and length of titanium dental implants using root form, external hex, rough surface screws.

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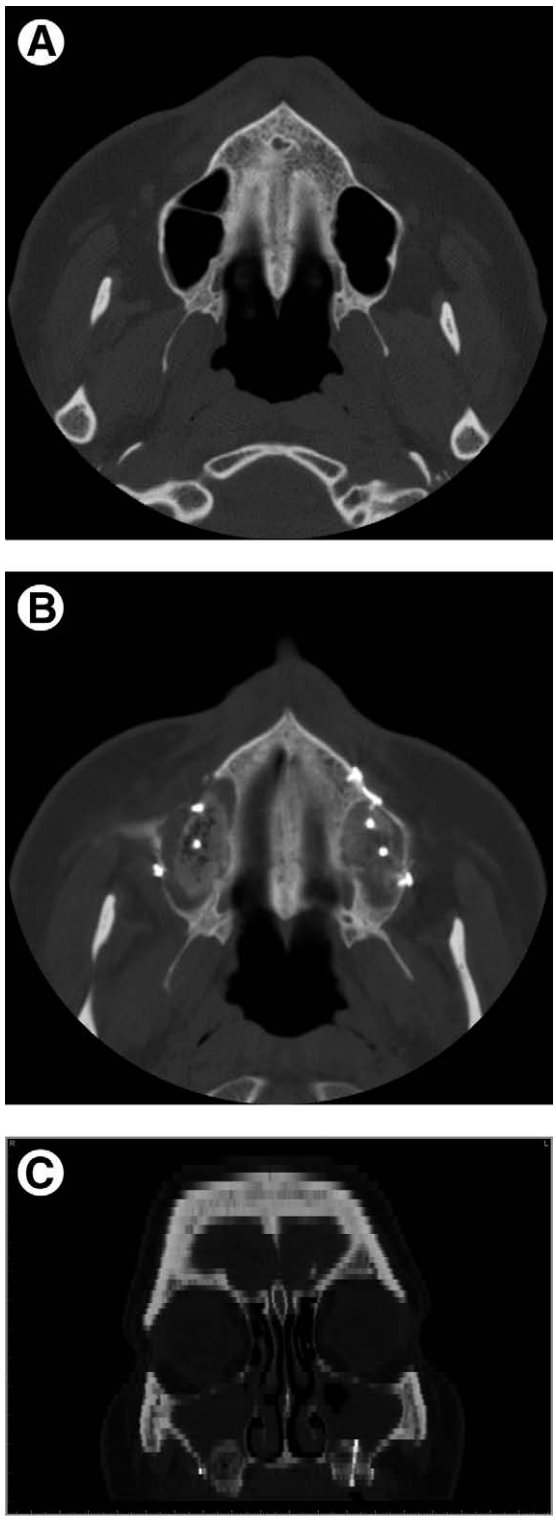

FIGURE 3. *A*, Preoperative CT scans showing the right anterior bony septum and the slight narrowing due to the left posterior septum, *B*, Postoperative CT scans showing the grafted bones with screws and plates positioned. *C*, Postoperative CT scan in frontal plane showing the grafted bones far from the opening of maxillary sinus (in the middle concha).

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tion, graft slumping, tissue encleftation, and wound dehiscences accounted for the remainder of the complications.[11]

Bone block grafts might be used as an alternative procedure in case of intraoperative major sinus membrane perforation; however the described reconstructive technique was adopted in the present case series because all patients were affected by severe atrophy of both the maxilla and mandible, requiring extensive reconstruction in different oral areas, and relatively large quantities of bone were harvested from the iliac crest to cover all requirements of the extensive reconstructions. Intrasinusal autologous corticocancellous bone block grafts were preferred in the highly atrophic cases treated because particulate grafts, xenografts as well as autogenous bone, demonstrated over time a possible reduction both in height[14,15] and in volume,[16,17] and particularly a remodeling around the implant apices leading to a bulging within the sinus.[14,15] Autogenous bone blocks grafted in atrophic sinuses registered a minor linear remodeling, at a statistically significant level, when compared with particulate grafts, leaving implant apices, on average, far from the sinus floor, and were associated with a 100% implant success rate. Intrasinusal particulate osseous grafts were associated with a lower implant success rate (89.3%).[14]

A further possible advantage of the described procedure might be the bicortical fixation in case of immediate implants compared with particulate graft procedure, for which the recommendation to achieve bicortical anchorage of dental implants, engaging dense cortical bone to both apical and marginal aspects to obtain an extra primary stability, appears impracticable.[18]

In the present report, repositioning of the bone lid, from the large sinus window, necessary for the proper positioning and securing of the large grafted bone blocks, was adopted both to counteract possible postoperative complications after a potential interruption of the lateral zygomaticomaxillary line strut,[19] and to avoid a residual lateral wall defect and soft tissue encleftation.[20]

In the present case series, at the second-stage procedure, all patients, even when affected by post–sinus-lift complications, showed complete restoration of the maxillary pillar. The only soft tissue encleftation occurred in a single sinus lift area that encountered partial graft necrosis. Bioresorbable and nonabsorbable membranes were used, in different studies, in sinus lift procedures, primarily to achieve perfect graft containment. Incidentally, no soft tissue encleftation, inflammation, dehiscence, or suppuration was observed in these studies.[21,22]

Regarding the surgical modeling, one possible benefit might be the improvement of the shape and the complete adaptation of the large corticocancellous block

graft to the recipient sinus floor in highly atrophic posterior maxilla. The preshaping could lead to an optimal rigid fixation of the block graft, also in the presence of intrasinusal bony septa. The rapid prototyping model allows, as well, a significant reduction of surgical time.

The prevalence of septa of either primary or secondary origin in the general population is considered to fall in the range of 13.2% to 31.7%.[23-25] Currently any surgical approach to the sinus lift technique is conservative regarding the bony septa, but the presence of such anatomical structures can bring about complications, such as perforations in the Schneider membrane and limitations in visual access and in the ability to graft into the sinus cavity during the surgical procedure.[23] Second to membrane perforations is the potential for the development of a maxillary sinusitis[12,13]; therefore complete removal of the septa,[2] including that achieved with modified sinus lift procedures, has been suggested.[26,27] The presence of septa in 3 sinuses in the present report, in addition to the extreme atrophy of the residual sinus floor, suggested the use of the reported aggressive surgical technique, allowing the adaptation of intrasinusal grafted bone blocks under complete visual control of the site.

The described technique resulted in a high prevalence of infections of the treated sinuses. The 2 patients showing sinusitis were treated perioperatively. with ceftriaxone, whereas the other patients, who received amoxicillin-clavulanic acid, had no complications. However, the data were too scant to give any clear indications.

Regarding bone block graft success, Pogrel considers graft failure "as loss of all or part of the graft."[28] Using such a definition, the present partial loss of one sinus graft may represent a 10% failure of the technique in this particular group of patients; nevertheless, also in the patient in whom a partial block graft failure occurred, implants were successfully positioned. A less restrictive definition of failure is that reported by Pjetursson, who defined failure as an "excessive graft loss resulting in inability of implant insertion," registered in 1.9% (range 0% to 17.9%) of cases using particulate grafts.[11] According to this last definition, the reported success for the described procedure, in the present small case series, appears to be 100%, inasmuch as implant positioning was possible in every grafted area with optimal primary stability, despite the partial bone loss in one single area.

This outcome might suggest a role for the technique in cases of severely atrophic posterior maxilla.

In conclusion, autologous bone blocks grafted in sinuses in extremely atrophic posterior maxillas, performed with lateral bone lid repositioning to avoid interruption of the lateral zygomaticomaxillary pillar and soft tissue encleftation, appears to be an effective, albeit aggressive, technique that is not free of complications. The occurrence of such complications, mainly postoperative sinusitis and related possible partial block graft failure, may discourage use of this surgical approach. More studies need to be conducted to better clarify the possible benefits and side/adverse effects of this technique.

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